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AUTHOR Mandler, Jean M.; DeForest, Marsha
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ABSTRACT

After presenting a brief description of the principles of a story grammar, some experimental results are summarized to illustrate the power of story schemata in controlling recall. Specially constructed versions of four stories were used with second, fourth, and sixth graders and in a second experiment with adults. One version of each story was structured to reflect an "ideal" form predicted by the story grammar; a second version mixed together elements from separate episodes of the ideal form. Results indicated that most retellings of the stories regrouped the elements in a pattern that reflected the ideal form. Comparisons between age groups indicated that children relied more heavily than adults did upon story schemata to organize memory and recall. (AA)

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The Code in the Node: Developmental Differences in the Use of a Story Schema

Jean M. Mandler and Marsha DeForest

University of California, San Diego

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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It is an impossible task to convey in 15 minutes the complexities and beauties of a story grammar, its utility in predicting both comprehension and recall of simple stories, and the psychological reality of story schemata based on the structural characteristics of this kind of text. In picking and choosing among these topics, each of which is extensive as well as important, I have decided to concentrate on the last topic, to give you a brief demonstration of the control of recall by a story schema, and a brief discussion of the power of this sort of theoretical construct.

My comments about the story grammar itself must necessarily be brief. For those of you who are interested in its details, a description of the grammar, plus some discussion of its use in predicting recall by children and adults, has recently been published, in the January issue of Cognitive Psychology. Very briefly, then, the underlying structure of stories can be represented as a kind of phrase-structure grammar, in principle similar to a sentence grammar of the kind with which we are already familiar. In the same way that a sentence can be broken down into a set of constituent units, so can a story. Informally, these units can be represented by a tree structure, each unit forming a node in the tree. More formally, it is represented by a set of rewrite rules, again similar to a sentence grammar. Just as a sentence can be rewritten as a noun phrase plus a verb phrase, so a story can be rewritten as a setting plus one or more episodes. Similarly, as a verb phrase can be rewritten as a verb plus a determiner plus a noun, so an episode can be rewritten as a beginning, a development, and an ending. And so forth.

We have found this grammar to provide an adequate representation of both single and multi-episode stories. In the same way that a sentence itself can

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consist of two sentences connected by "and", so can stories consist of two or more temporally connected episodes. First one episode happens, then another. Finally, just as sentence grammars allow us to construct rather complicated sentences in which one sentence is embedded in another, so can stories embed one episode within another and thus produce tightly connected but rather complicated structures.

To carry this comparison one step further, the grammar describes the underlying structure of a story and is somewhat like the notion of a deep structure of a sentence. This underlying structure can be realized in somewhat different surface forms, all of which make a well-formed or canonical story. Just as the deep structure of a sentence can be realized in an active or passive surface structure, so can the underlying structure of a story admit a certain number of transformations and its surface form still be accepted as a story by the listener. However, only some kinds of transformations can occur, and these appear to be rather stringently determined by a limited set of transformational rules. We are currently working on these rules. They specify which units of a story may or may not be deleted. These rules, in fact, predict some of the data which Nancy Stein reported in her paper for this symposium. The rules also specify the extent to which the temporal sequence of units can be shifted around (provided the shifts are accompanied by appropriate markers), while maintaining a well-formed realization of a story.

Today I want to present a rather extreme case of shifting units around in the temporal sequence of a story and use this example to show the power of a story schema in controlling recall. We believe that through experience with hearing stories and experience with typical event sequences in the world, people form cognitive structures that reflect the underlying structure of stories as outlined by the grammar. Such "story schemata" consist of sets of expectations about the units making up a story and how stories typically proceed. The

plausibility of our analysis of the underlying structure of stories and the schemata which are derived from them will be much enhanced if we can demonstrate the way in which these structures control memory.

Although there are a number of higher and lower level nodes in the underlying structure of a story, the important units for our purposes here are what we call the basic nodes. A story begins with a Setting node, i.e., one or more propositions which introduce the protagonist and other characters and sometimes the locale of the story. There follow one or more Episodes. Each episode consists of a Beginning node, i.e., an event which causes a protagonist to react in some way. The Reaction node consists either of a thought or emotional response and/often a goal-- some aim which the protagonist wishes to achieve. If there is a goal, the Reaction is followed by an Attempt to reach the goal, and the attempt in turn results in an Outcome node. This immediate outcome of the attempt is in turn followed by an Ending, which typically ties the episode together, often referring back to the Beginning or Reaction.

You will probably have noted the unfortunate but inevitable differences in terminology between this talk and the last one. Nancy Stein's use of the term "consequence" is closer to our Outcome than to our Ending node. In addition, her characterization of story structure varies somewhat from ours. These details, however, are probably of more interest to the aficionados of story grammars and are relatively unimportant to the general principles discussed here.

Even though this is a badly oversimplified outline of the grammar, let me illustrate it by showing you a simplified version of the underlying structure of the four stories we used in the present study. We wrote four stories structured in a canonical THEN-connected two-episode format. The numbers under each node

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Slide 1

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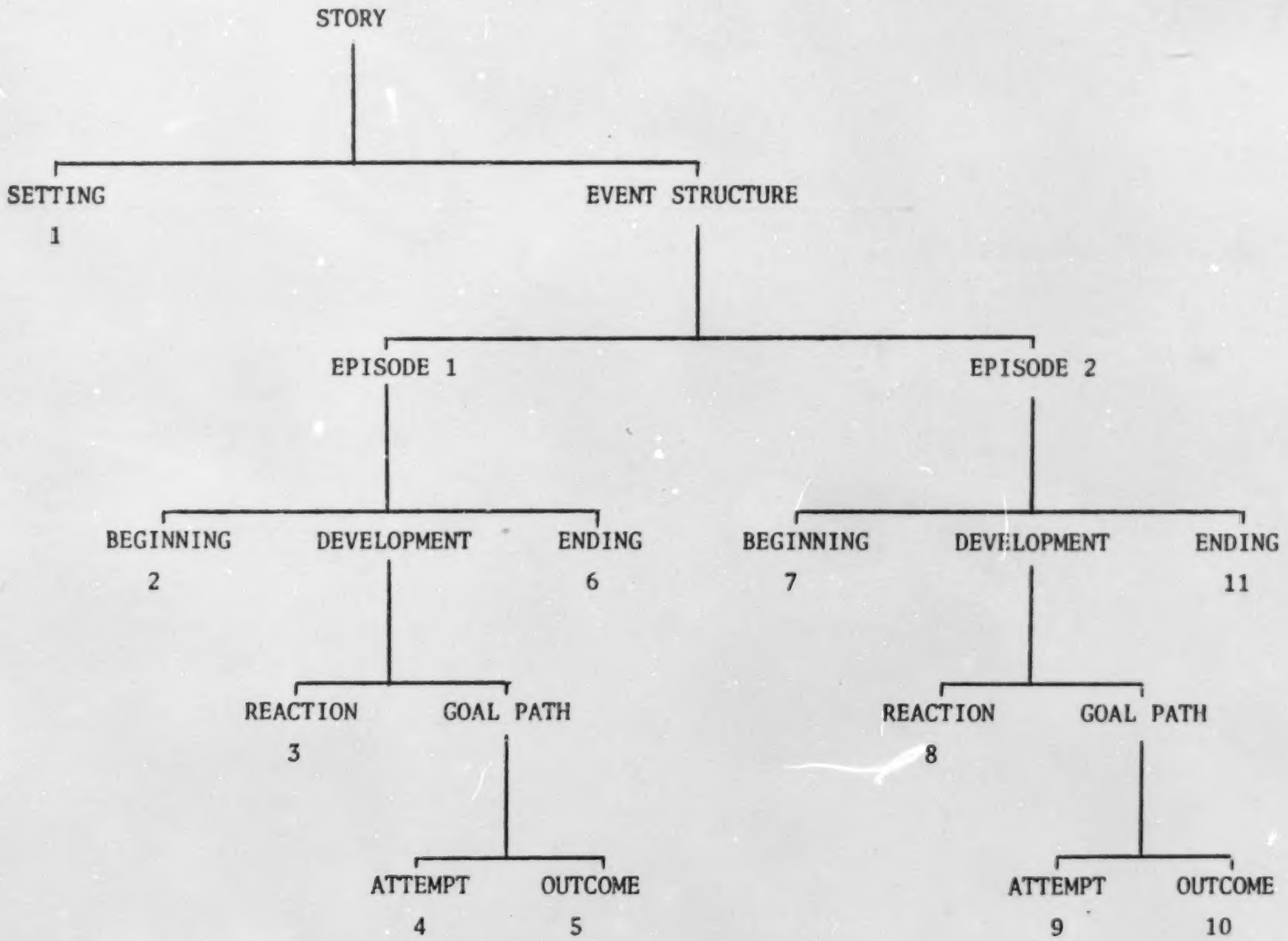
represent the order in which the propositions representing the nodes occur. This is the ideal version, and one of the ideal stories sounded like this:


STORY
SETTING
1
EVENT STRUCTURE
EPISODE 1
EPISODE 2
BEGINNING
2
DEVELOPMENT
ENDING
6
BEGINNING
7
DEVELOPMENT
ENDING
11
REACTION
3
GOAL PATH
REACTION
8
GOAL PATH
ATTEMPT
4
OUTCOME
5
ATTEMPT
9
OUTCOME
10

Setting: Once there were twins, Tom and Jennifer, who had so much trouble their parents called them the unlucky twins.

Episode 1

Beginning: One day, Jennifer's parents gave her a dollar bill to buy the turtle she wanted, but on the way to the pet store she lost it.

Reaction: Jennifer was worried that her parents would be angry with her, so she decided to search every bit of the sidewalk where she had walked.

Attempt: She looked in all the cracks and in the grass along the way.

Outcome: She finally found the dollar bill in the grass.

Ending: When Jennifer got to the store, the petstore man told her that someone else had just bought the last turtle and he didn't have any more.

Episode 2

Beginning: The same day, Tom fell off a swing and broke his leg.

Reaction: He wanted to run and play with the other kids.

Attempt: So he got the kids to pull him around in his wagon.

Outcome: While they were playing, Tom fell out of the wagon and broke his arm.

Ending: Tom's parents said he was even unluckier than Jennifer and made him stay in bed until he got well.

A sad tale, but an ideal one in its structure. We created four stories like this (though most of them were happier), and then we made alternate versions of each story. The alternate versions systematically interleaved the nodes of the two episodes. First the Setting was presented, then the Beginning of the first episode, followed by the Beginning of the second episode. Then the Reaction of the first episode, followed by the Reaction of the second episode, etc. The interleaved stories sound just slightly strange to our story-accustomed ears, but nevertheless have a symmetrical structure which one might think would make them memorable. Not so, according to the grammar. Here is the interleaved version of the story I just read.

Setting: Once there were twins, Tom and Jennifer, who had so much trouble their parents called them the unlucky twins.

Beginning 1: One day, Jennifer's parents gave her a dollar bill to buy the turtle she wanted, but on the way to the pet store she lost it.

Beginning 2: The same day, Tom fell off a swing and broke his leg.

Reaction 1: Jennifer was worried that her parents would be angry with her, so she decided to search every bit of the sidewalk where she had walked.

Reaction 2: Tom wanted to run and play with the other kids.

Attempt 1: Jennifer looked in all the cracks and in the grass along the way.

Attempt 2: Tom got the kids to pull him around in his wagon.

Outcome 1: Jennifer finally found the dollar bill in the grass.

Outcome 2: While the kids were playing, Tom fell out of the wagon and broke his arm.

Ending 1: When Jennifer got to the store, the petstore man told her that someone else had just bought the last turtle and he didn't have any more.

Ending 2: Tom's parents said he was even unluckier than Jennifer, and made him stay in bed until he got well.

The only difference in the propositions in this version of the story is the occasional substitution of proper names for pronouns to provide unambiguous referents for each of the nodes.

When we speak of the psychological reality of story schemata, we mean that there exist cognitive structures which determine not only comprehension but also govern the quantity and quality of recall. That is, we presume that each proposition is comprehended as it is input, but its meaning, as well as its retrievability, is determined by the extent to which it is integrated with other propositions that are input. Further, the schema selects which propositions will be integrated into units. Even if presented out of order, subjects will nevertheless determine that the story has two episodes, and in their processing will relate, e.g., the first Beginning with its Reaction, not with the second Beginning. Two predictions follow. First, even when the subject is asked to reproduce the exact input order, output will be determined more by the ideal story schema order than by the input order. Second, more effort is required to integrate interleaved episodes than ideally separated ones, and therefore one can expect more failures of integration during both comprehension and retrieval. Such failures should be reflected in decreased quantity of recall as well as increased distortions, importations of new material, backtracking,etc.

In our first experiment we presented second, fourth, and sixth graders with four stories like the ones I just read. Half of the subjects heard the ideal versions, half the mixed versions. After twenty-four hours the subjects were asked to recall all four stories exactly as they had heard them.

A brief summary of the results is that out of 114 recall protocols from the

mixed stories, only 2 maintained the input order. All the others clustered output into separate episodes or parts of episodes. The amount of clustering varied, of course, from subject to subject, but overall it was high indeed. The clustering measure that was used was RRR (relative ratio of repetition) which varies from 0 to 1.0. The average clustering score for subjects hearing the mixed stories was .73. Thirty-four (30%) of the protocols showed perfect clustering, i.e., the two interleaved episodes were completely separated in output. The rest of the protocols showed intermediate clustering, the most typical pattern being maintenance of the input order through the beginnings of both episodes, followed by separation thereafter. That is, subjects could maintain the interleaved structure for a few propositions but then showed greater dependency on the ideal structures for the rest of their recall.

Interestingly enough, overall there was no difference in number of propositions recalled from the ideal and the mixed versions of the stories. What we forgot in our original predictions about interleaved stories was <u>another</u> prediction of the grammar, namely that the THEN-connection between episodes is a weak one, and should lead to relatively frequent lack of recall of the entire second episode of two temporally connected episode stories. That is exactly what happened. More subjects hearing the ideal versions totally omitted the second episodes, whereas, not surprisingly, subjects hearing mixed versions typically recalled at least some propositions from each. When the data were rescored for number of propositions recalled from episodes, given that those episodes were remembered at all, then recall was superior for the ideal versions. Mixed versions also produced more distortions in recall, but we are still in the process of analyzing these data.

I also want to comment on the most important developmental trend in these data, a trend which I believe is found in all cognitive walks through life, and one to which we perhaps do not pay enough attention. Is it the case that the younger children are less sensitive to the structure of stories and thus are

less influenced by structure in their rec all? Have second graders not yet developed story schemata like those found in adulthood? Well, perhaps, in some of the more sophisticated details, but our data suggest that on the whole it is the other way around. Not only have children learned these schemata, but they are more dependent on them than are adults for comprehension and memory.

We have found this general result in many different kinds of developmental studies in our lab. Children are more dependent on the structural characteristics of both visual and verbal materials for retrieval. Mess around with familiar structures and children get lost. In the present study, this dependency on ideal structures is shown in the following way. All grades showed a fairly high degree of clustering of recall into separate episodes. But if we look at the number of subjects who recalled all mixed stories in separated form (as defined by complete separation or only one node out of ideal order) we find that 73% of the second graders were in this category, 55% of the fourth graders, but only 8% of the sixth graders.

This result is amplified by considering a second experiment using adults as subjects. (There were some differences in method; for example, adults were presented with both mixed and ideal stories as a within rather than between subjects variable, and thus received only two mixed stories). Adults were more likely to be able to maintain the original input order. Their clustering scores, while still substantial, dropped to .57. For adult subjects who recalled after a week's delay,however, clustering scores rose to .64; after two weeks delay they rose to .77. Similarly, if we look at the number of subjects who recalled both mixed stories in separated form, 48% of the adults in 24-hour recall were in this category. (This mean is considerably higher than for the 6th grade, and may be due to having only two mixed stories to recall or to the presence of standard stories as well, or both. This group is being replicated to coincide exactly with the method used with children). Of adults who recalled after a week, 35% were

in this category, but after two weeks 80% of the adults recalled both mixed stories in separated form.

These data indicate that adults are reasonably able to maintain an unfamiliar story format in its input order for a brief period of time. But after a delay, the story schema overrides the input order and results in an output order corresponding to the ideal schema, not the story actually heard.

We have all become accustomed to the notion that people do not maintain the exact surface structure of sentences they hear. They do, however, maintain the structure of the higher order relationships among sentences. They reconstruct the input to reflect those relationships and use their structural knowledge as a retrieval aid during output. In this sense they recall what they know rather than what they heard. Finally, it is of some interest to note that compared to adults, young children are notoriously unresponsive to the categorical structure of lists of taxonomically related words. Unless given a lot of help they do not use the structure provided to organize their recall. However, when it is a question of the structure of a kind of prose which is highly meaningful to them and with which they had had extensive experience, they not only use that structure but depend on it to organize recall even more than do adults.